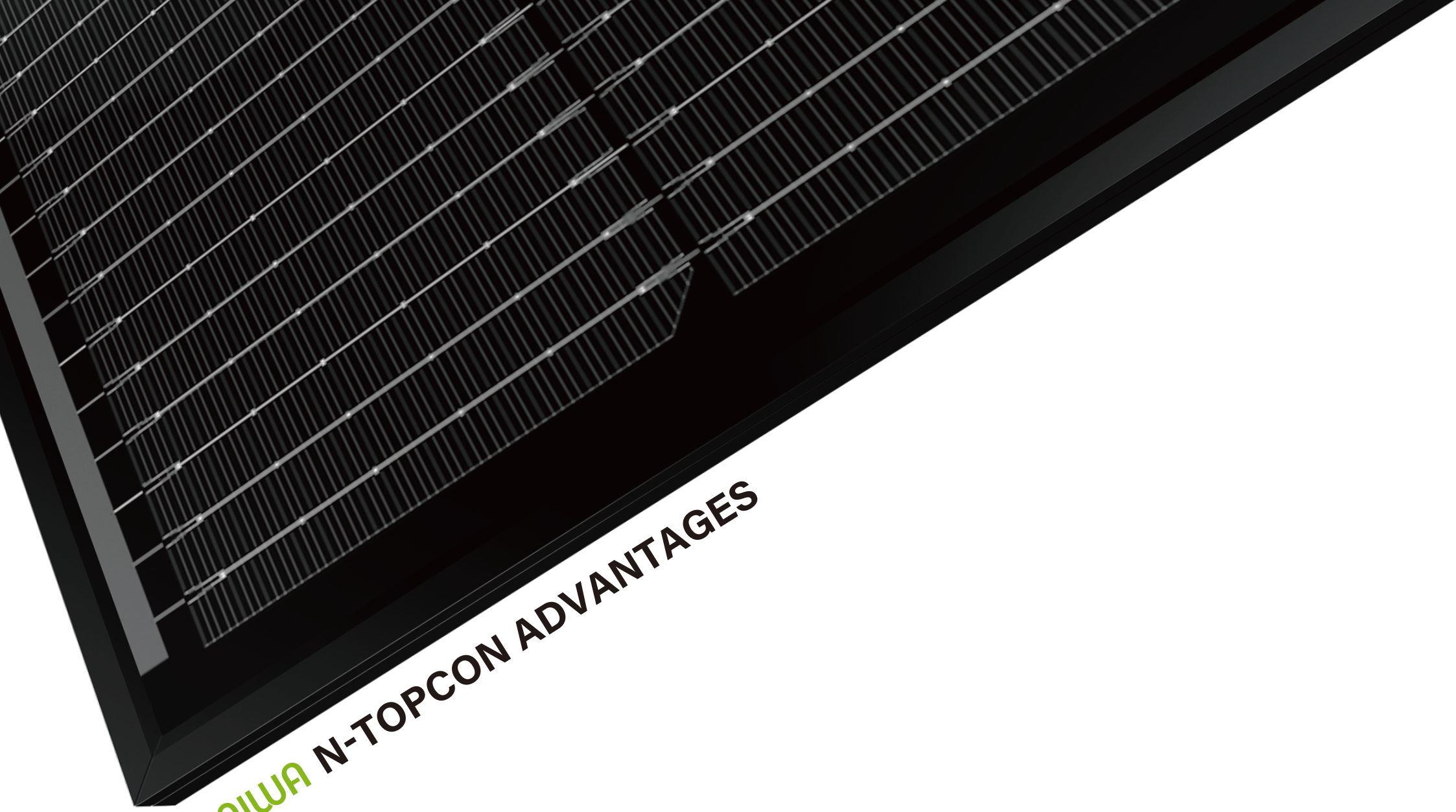
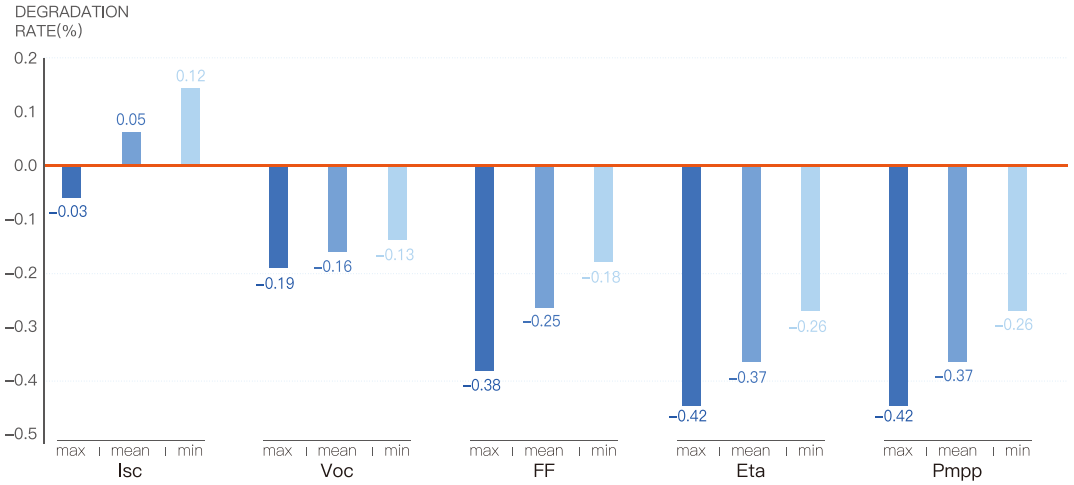


NIWA N-TOPCON ADVANTAGES

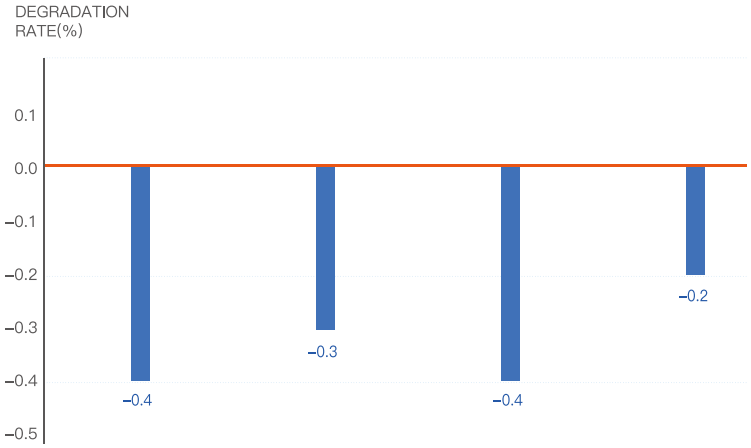
JOLYWOOD

ZERO LID & LOW RISK LETID

Jolywood N–TOPCon module has a negative degradation rate of overall power generation under LID test (Test Agency: Fraunhofer ISE)
After 4round of LeTID test under condition 75C, 1A, 96 hours/ round,degradation rate <0.4% (Compare with PERC <1.5%)

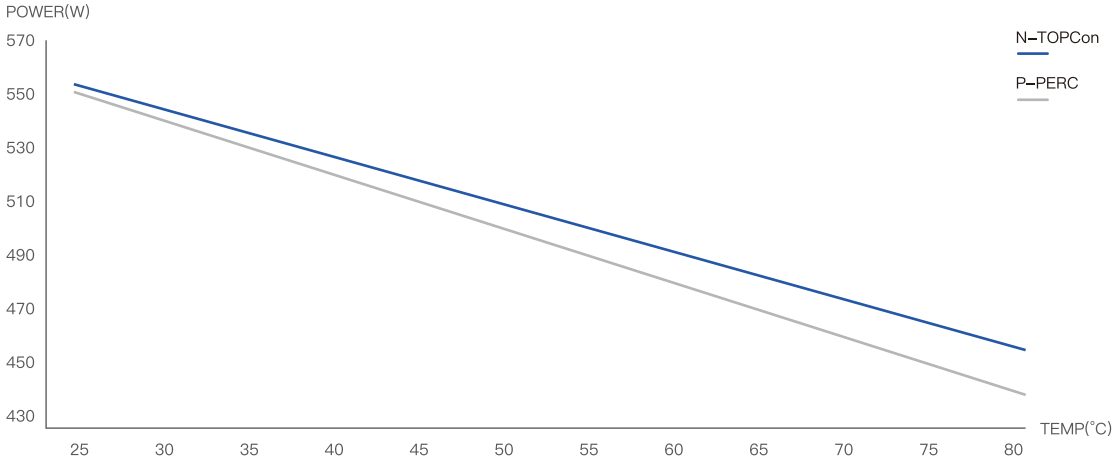


Characteristics change of Jolywood Bifacial N TOPCon module after LID testTest Agency:Fraunhofer ISE
Test Condition:20kWh/m2



Characteristics change of Jolywood Bifacial N TOPCon module (after LID test) after LeID test
Test Condition:75C,current:1A, 96 hours/round

Output Power under Different Temperature



LOWER TEMPERATURE COEFFICIENT

1

N–TOPCon module has better Temperature Coefficient (–0.30%/℃) than P type (–0.35%/℃)

2

Under same environment condition, N– TOPCon module has lower working temperature (>1℃) than P type module

3

Under high temperature environment, N–TOPCon module has 1% power gain compare with P–PERC module

BIFACIAL TECHNOLOGY

Bifacial Rate:
N-TOPCon 85%

VS

Bifacial Rate:
P-PERC 75%

POWER GAIN AT DIFFERENT SURFACE

Green grass
Albeto=0.25

Dry grass
Albeto=0.33

Humid soil
Albeto=0.15

Snow
Albeto=0.90

Normalized power generation

kWh/kWp/yr		alberto=0.25	alberto=0.33	alberto=0.15	alberto=0.90
N-TOPCon	80% (±5%)	1492	1570	1336	2175
PERC	70% (±5%)	1398	1456	1267	1961
POWER GAIN		6.78	7.85	5.46%	10.91%

Note: Data based on PVsyst, estimate base on Jolywood N-TOPCon HD144-575W and PERC 570W

Higher bifacial rate compared with PERC

UP TO
85%

The additional power gain

UP TO
30%

N VS P TYPE CASE STUDY

Real Case Project 1 Hebei, China

Location
Hebei, China

Installation Type:
Fixed adjustable+tracking bracket

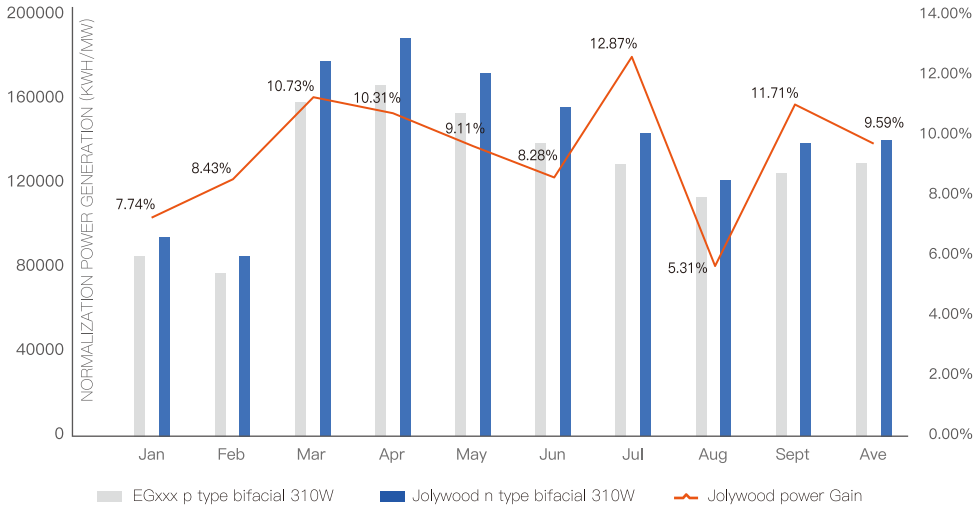
Inverter:
Sungrow

JOLYWOOD N-TOPCON BIFACIAL MODULE

vs P-PERC monofacial module has **9.42%** Power Gain

Power Generation of N-TOPCon vs P-PERC

Between 2021.1-2021.9



Real Case Project 2 Jilin, China

Location
Jiling, China

Installation Type:
Tracking bracket

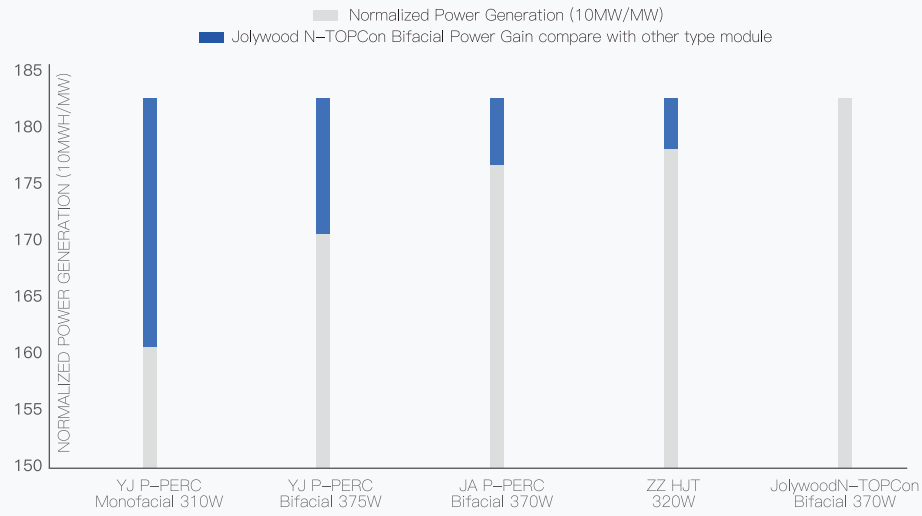
Inverter:
Sungrow

JOLYWOOD N-TOPCON BIFACIAL MODULE

vs YJ P-PERC monofacial module has **12.56%** Power Gain
vs YJ P-PERC bifacial module has **5.86%** Power Gain
vs JA P-PERC bifacial module has **2.45%** Power Gain
vs ZZ HJT module has **1.87%** Power Gain

Power Generation of N-TOPCon vs P-PERC vs HJT

Between 2020.1.1 – 2020.12.31



ESTIMATION CASE 1- GERMANY COMMERCIAL SYSTEM

Item	Unit	PERC bifacial	NTOPCon bifacial	NTOPCon bifacial
Annual effective irradiation hours	h/year	1200	1200	1200
Module power	Wp	450	460	465
Module price	$/Wp	0.279	0.304	0.306
Effective power	Wp	411	429	434
Total cost per watt in life (discounted)	$/Wp	0.782	0.802	0.801
Initial investment per watt	$/Wp	0.729	0.749	0.749
BoS	$/Wp	0.45	0.446	0.444
LCOE	$/kwh	0.0369	0.0369	0.0369

Note: 1.N–TOPCon module bifaciality 85%, temperature coefficient –0.30%/℃, 1st year degradation 1%, annual degradation 0.4%
2.PERC module: bifaciality 75%, temperature coefficient –0.34%/℃, 1st year degradation 2%, annual degradation 0.45%

a

Suppose the LCOE is the same, N–TOPCon module has an extra value of 2.5 ~ 2.65 USC/Wp vs P–PERC module.

ESTIMATION CASE 2- SPAIN UTILITY SYSTEM

Item	Unit	PERC bifacial	NTOPCon bifacial	NTOPCon bifacial
Annual effective irradiation hours	h/year	1650	1650	1650
Module power	Wp	545	545	575
Module price	$/Wp	0.272	0.293	0.31
Effective power	Wp	502	514	542
Total cost per watt in life (discounted)	$/Wp	0.896	0.919	0.917
Initial investment per watt	$/Wp	0.722	0.743	0.750
BoS	$/Wp	0.45	0.45	0.439
LCOE	$/kwh	0.0296	0.0296	0.0296

Note: 1.N–TOPCon module bifaciality 85%, temperature coefficient –0.30%/℃, 1st year degradation 1%, annual degradation 0.4%
2.PERC module:, bifaciality 75%, temperature coefficient –0.34%/℃, 1st year degradation 2%, annual degradation 0.45%

b

Suppose the LCOE is the same, For the same Module power, NTOPCon module has an extra value of 2.1 USC/Wp Vs. P–PERC module.
N–TOPCon module has a higher power of 30W, which brings a premium of 3.8 USC/W.